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Dear Inquirer:

Thank you for your interest in the Arcade Board sprite graphics and sound effects generation peripheral for Apple II compatible computers. The following information should answer any questions you may have about our product. Feel free to call or write for further information.

WHAT IS THE ARCADE BOARD?

The Arcade Board is a peripheral board for Apple II compatible computers that allows you to have TRUE ARCADE QUALITY color graphics and sound effects for use in your own programs. No doubt, you've seen ads for game programs claiming to have 'true arcade quality action and sound'. However, this is simply not possible, because the Apple II's video and sound circuitry (designed in 1976) is just not capable of generating real arcade quality graphics and sound effects. But now, thanks to the advanced hardware used on the Arcade Board, YOU CAN CREATE SPECTACULAR, ARCADE QUALITY, 16 COLOR, HIGH RESOLUTION GRAPHICS, WITH RAPID AND SMOOTH ANIMATION, AND SIMULTANEOUS SOUND EFFECTS AND MUSIC. The Arcade Board's graphics and sound effects are far superior to those of the standard Apple, and are comparable to those of the coin-operated video arcade game machines. This is only natural, since the Arcade Board uses the same state-of-the-art technology as used in these machines. The Arcade Board transforms your Apple from a mediocre graphics and sound machine to a truly first rate video game machine.

NO MACHINE LANGUAGE KNOWLEDGE REQUIRED!

Even better, the Arcade Board allows you to do all the things mentioned above using ONLY Applesoft BASIC! No longer do you need to know machine language in order to have decent animation and sound effects. Not only that, but the graphics and sound effects, which you can create using the Arcade Board with Applesoft BASIC, are far superior to what a top notch machine language programmer can do with standard Apple graphics and sound!

THE 'AMPARCADE' GRAPHICS AND SOUND PROGRAMMING LANGUAGE

Best of all, you can program the Arcade Board with our easy-to-use, 'Amparcade' graphics and sound programming language. The

'Amparcade' language is a set of over 50 ampersand (&) command extensions to Applesoft BASIC allowing you to control the powerful features of the Arcade Board with the EASE and CONVENIENCE of BASIC, but with the blinding execution speeed of machine language.

POWERFUL HARDWARE MAKES THIS POSSIBLE

The powerful hardware used on the Arcade Board was specifically designed for use in commercial video arcade game machines. This hardware is so powerful and sophisticated, that graphics and sound effects that once were impossible to create, or required complicated and time-consuming machine code, have now become routine and common-place.

CREATE YOUR OWN SPECTACULAR ARCADE GAMES!

Imagine being able to write your own FAST ACTION arcade game programs, ... in BASIC! Imagine these games having up to 32 (64 if you use a special programming technique) independently movable colored objects (sprites) whizzing around RAPIDLY and SMOOTHLY on the screen. Imagine these sprites changing their shapes and colors as they move. Imagine hearing complex sound effects such as laser blasts, explosions, gunshots, whistles, sirens, music etc. as these sprites move across the screen. Imagine being able to make the background flash rapidly in different colors when there is a collision and to hear the REALISTIC sound of an explosion. Imagine being able to rapidly page flip between four different pages of spectacular, 16 color, high resolution color graphics for rapidly changing background scenes. Imagine being able to easily detect collisions between objects. Imagine having a commercial, coin-operated video arcade machine plugged into your Apple. Now you can imagine what the Arcade Board can do!

EXAMPLES OF THE POWER AND EASE OF USE OF THE ARCADE BOARD

Following are just a few of the possible examples illustrating just how powerful and easy-to-use the Arcade Board is.

EXAMPLE 1: CHANGING THE BACKGROUND COLOR:

Changing the background color in Apple Hires graphics consists of changing the over 8000 bytes of data that define the Hires graphics page. This is not only slow, even for machine language, but also may be difficult, if not impossible, when there are patterns covering the background color.

On the Arcade Board, changing the background color is a simple matter; merely change the contents of a single register on the video chip. This is easily done using the 'Amparcade' command:

```
& BCOL, B
```

This command changes the background to one of the 16 possible colors represented by the variable B. None of the patterns on top of the background color are disturbed. The background color can be changed 60 times a second using this command. This is useful for simulating explosions by having the background flash different colors in rapid succession.

EXAMPLE 2: ANIMATION:

Moving an object in regular Apple Hires graphics requires that the object first be erased at the old location, and then redrawn at the new location. In addition, the background pattern or color of the old location must be restored, and that of the new location must be saved for future restoration. This requires complex and time consuming routines consisting of hundreds, or even thousands, of 6502 machine language instructions.

Animation on the Arcade Board is super-easy! The Arcade Board features easily-movable objects, called 'sprites', that can be moved anywhere on the screen merely by specifying their new horizontal and vertical positions. This is all that needs to be done! The Arcade Board's hardware automatically moves the sprite on the screen, saving and restoring the background patterns and colors as necessary. What could be faster and easier?

The three main commands to move a sprite are:

```
& SPRX, S, X         (for horizontal movement)
& SPRY, S, Y         (for vertical movement)
& SSPR, S, Y, X      (for both vertical and horizontal movement)
```

The variable S represents which one of the 32 allowed sprites is to be moved, and the variables X and Y represent the horizontal and vertical positions to which the sprite is to be moved. These commands are very fast and can move several sprites rapidly and smoothly across the screen.

EXAMPLE 3: CHANGING THE SHAPES OR COLORS OF OBJECTS:

In Apple graphics changing the shape or the color of an object is similar to moving it. You have to erase the old shape and color and replace it with the new shape and color. This is time consuming and requires hundreds of machine language instructions.

On the Arcade Board you can have up to 32 sprites active at any given time. But you can have up to 256 different, user-defined sprite shapes to choose from. To change a sprite's pattern, merely tell the video chip which one of the 256 different shapes is to be 'carried' by the sprite. Changing the color of any sprite is a similar operation. The main 'Amparcade' commands to change a sprite's shape and color are:

```
& SPAT, S, P         (for changing the shape)
& SCOL, S, C         (for changing the color)
& SSPR, S,Y, X, P, C       (changes position, shape & color)
```

The variable S is the sprite number, P and C represent the pattern and color respectively, and X and Y are the positions.

EXAMPLE 4: SOUND AND MUSIC GENERATION:

Creating sound effects and music on the Apple II requires constant toggling of the speaker I/O port. The rate at which this is done determines the frequency of the tone. The 6502 microprocessor must continue to do this for as long as the sound is to be heard. This ties up the 6502, making it difficult to do other useful things, such as animation. For this reason, arcade games for the Apple II lack decent sound effects.

On the Arcade Board creating a sound is a simple matter. Merely tell the sound chip which one of the three voices to use, the pitch, and the volume of the sound, and the sound generator chip takes it from there. The 6502 can go on and do other useful things. The main 'Amparcade' commands for sound generation are:

```
& TNA, P, V
& TNB, P, V
& TNC, P, V
& NSA, P, V
& NSB, P, V
& NSC, P, V
```

The variable P is the pitch and V is the volume. The first three commands are for tone generation for each of the three channels, A, B, and C respectively. The last three commands are for noise generation for the same channels. Noise is useful for gunshots, bombs, steam, hisses, etc. In addition there are many other tone and noise commands for such things as 2 or 3 note chords, automatic envelope control, programmable filters, envelope periods and types, etc.

PROFESSIONAL GAME DEVELOPMENT SYSTEM

We are working on a comprehensive set of utility programs which together will form a sophisticated arcade game development system. There will be interactive graphics editors allowing easy creation and editing of sprites, tile patterns, and graphics screens. There will also be a sound effects editor which will allow you to design and instantly play back sound effects and store them for future use. A music entry editor will allow entry of three voice musical compositions where the pitch, duration, tempo, scale, volume, timbre, special effects (such as tremolo, vibrato, beats, chorus, etc.) and ADSR envelope control can be entered. Subroutines in BASIC, 6502 source code, and Z80 source code (for ColecoVision game development) will be provided for all the basic functions necessary for arcade games.

The Game Development System will be of use to those of you who wish to use the Arcade Board to develop games for the coin-operated video arcade machines, the ColecoVision home arcade game system (which uses similar hardware), computers supporting the new Microsoft MSX graphics and sound standards, and, of course, the Apple II with an Arcade Board. Several companies which develop software for the coin-operated arcade game machines have bought the Arcade Board for this purpose. The combination of an Apple II with an Arcade Board makes an excellent and economical arcade game development system.

TECHNICAL SPECIFICATIONS OF THE ARCADE BOARD

The Arcade Board is a high quality, double sided, solder masked and silk-screened, printed circuit board on a glass-epoxy substrate with gold plated edge connectors. It contains 17 fully socketed integrated circuit chips and over 20 other discrete components.

The Arcade Board works in any slot, except slot 0, and is compatible with all other Apple peripherals which conform to the standard I/O interfacing conventions mentioned in the Apple Reference Manual. Practically all Apple peripheral manufacturers conform to this standard.

The Arcade Board requires an Apple II compatible computer with at least 48 K of RAM. The 'Amparcade'- prgramming language requires Applesoft BASIC in ROM or in a 16 K RAM card. Only one monitor or TV is required, as the Arcade Board has a built-in softswitch to select between regular Apple video or Arcade Board video. Two monitors or TV's can be used to see both regular Apple video and Arcade Board video at the same time. The video output is NTSC compatible composite video.

The two main chips used in the Arcade Board are the Texas Instruments TMS 9918A Video Display Processor (VDP) and the General Instruments AY-3-8910 Programmable Sound Generator (PSG). These chips are mainly responsible for the powerful capabilities of the Arcade Board.

TMS 9918A VIDEO DISPLAY PROCESSOR FEATURES:

- SPRITES: The main feature of the VDP chip is its 32 sprites which allow for super-easy animation. A sprite is an object whose shape you define. A sprite can be up to 32 x 32 pixels in size. Once the sprite's shape is defined, it can easily be moved around the screen by merely telling the VDP the new X and Y position values for the sprite. It is just as easy to change the shape or color of the sprite.

- RESOLUTION: The resolution of the VDP's high resolution graphics modes is 256H x 192V. This is almost double the horizontal resolution of Apples's Hires graphic's TRUE color resolution of only 140H x 192V. The Apple's claim of 280H x 192V Hires resolution is incorrect, as only every other dot can be turned on or off for each of the four Hires colors available. The increase in the Arcade Board's resolution is quite noticeable, and the colors look richer and brighter, as the density of pixels is almost twice as great.

- COLORS: The VDP features 16 colors, which are all available simultaneously in each of the three VDP graphics modes. The colors are: dark red, medium red, orange, dark yellow, light yellow, dark green, medium green, light green, cyan, medium blue, light blue, violet, grey, white, black, and transparent.

- HIRES GRAPHICS: The VDP has two high resolution graphics modes, each with a 256H x 192V resolution and 16 colors. Graphics Mode 1 requires far less memory than Graphics Mode 2, but has more restrictions on color usage. Graphics Mode 1 is usually the mode used for most arcade games. There can be 4 independent pages of Graphics Mode 1 screens available for rapid page flipping. There can be only one screen of Graphics Mode 2.

- LORES GRAPHICS: The low resolution graphics mode of the VDP is similar to Apple Lores, except the resolution is 64H x 48V, with SQUARE pixels. There are four independent pages of 16 color, Lores graphics available for page flipping.

- TEXT: There is a 24 row by 40 column text mode requiring a user-defined character set. This is useful for special symbols, foreign alphabets, etc. Only two colors of your choice can be selected from the available 16 colors in this mode. There are 14 different pages of text for page flipping!

- MULTIPLANAR GRAPHICS: The architecture of the VDP's graphics can be logically thought of as a stack of 35 planes of clear glass. The 32 planes nearest to your eyes each contains a single sprite which is free to move anywhere on the plane. These sprite planes are transparent everywhere except where the sprites are. The 33rd plane is the pattern plane and is used to draw a multicolored pattern covering the whole plane. The pattern plane is the usual graphics plane of more conventional graphics systems. Behind the pattern plane is the backdrop plane which is a solid color. The sprites, as they pass over the pattern plane temporarily obscure the pattern plane and also each other, depending on their priorities. Sprites on planes nearer to your eye have higher priorities than those nearer to the pattern plane. All sprites have priority over the pattern and backdrop planes. This allows for pseudo 3 D effects.

- VIDEO MEMORY: The Arcade Board has 16 K of video RAM which is used by the VDP for graphics information storage. None of the Apple's RAM is used for graphics, therefore you can use the extra 16 K of Apple Hires pages 1 and 2 for programs and data.

- TABLE DRIVEN GRAPHICS: The VDP uses the advanced technique of table driven graphics. This technique is used by most of the advanced graphics systems. Its main advantage is that it allows for extremely rapid changes of the graphics screen. The VDP has five tables which define the graphics screen. There is room for several alternate tables in video RAM, but only five are active at any given time. Changing the elements of the active tables creates animation. Swithcing to a completely new table allows for extremely rapid animation. If the VDP had no sprites whatsoever, it could still feature rapid animation just by using table driven graphics!

- 60 Hz INTERRUPT: The VDP generates an interrupt signal at the start of the vertical retrace period. This happens every 60th of a second. This can be used for general purpose timing, or to synchronize screen flipping.

AY-3-8910 PROGRAMMABLE SOUND GENERATOR FEATURES:

- VOICES: The PSG has 4 voices: 3 tone generators and a noise generator. The 3 tone voices can be used to create 3-voice musical compositions, 3-note chords, additive synthesis of musical instrument sounds, chorus effects, beats, vibrato, and frequency sweep effects (laser blasts, bombs falling, wolf whistles, etc.). The noise generator is used to simulate explosions, gunshots, steam hissing, water rushing, wind, waves breaking on a beach, drums, cymbals, tambourines, and much more.

- FREQUENCY RANGE: The frequency range of each of the tone generators is from 32 Hz to 128 KHz, a nine octave range. The noise generator has a 'frequency' range of 4KHz to 128 KHz.

- VOLUME CONTROLS: Each of the 3 tone generators has an independent, 16 level volume control. The volume of the noise generator can be controlled by any or all of these same volume controls. By manipulating the volume of a sound with time, many interesting effects can be created. Tremolo, bells and chimes, piano, harpsichord, guitar, banjo, etc. The automatic envelope control feature can do many of these things automatically, but manual volume control manipulation is more flexible, even allowing the creation of such complex sounds as human speech.

- AUTOMATIC ENVELOPE CONTROL: The automatic envelope control feature of the PSG varies the volume of a tone automatically as the note is played. This is done by specifying the length of time during which the volume changes are to take place (the envelope period) and how the volume will change over this period (the envelope shape). With this feature it is easy to simulate such decaying sounds as piano, harpsichord, gunshots, bombs, etc.

-PROGRAMMABLE FILTERS: The PSG's sound output is passed through a set of programmable filters. There are 16 different software-selectable filters to choose from: 4 low pass filters, 4 high pass filters, 4 band pass filters, and 4 notch pass filters. Each type of filters has 4 different cut off or center frequencies. The filters are used to create a wider range of sound effects and can be used to simulate various musical instrument sounds, such as flute, strings, horns, bagpipes, etc.

WHAT COMES WITH THE ARCADE BOARD

The Arcade Board comes with a tutorial-reference manual and a demo disk, which includes the 'Amparcade' graphics and sound language. Included in the manual is a section on installation, testing and trouble-shooting. The introductory tutorial covers the basic features of the Arcade board's hardware and how to use the 'Amparcade' language. Complete documentation on the functions of each of the over 50 'Amparcade' commands is included. The technical reference section explains in detail the features and programming of the TMS 9918A Video Display Processor, the AY-3-8910 Programmable Sound Generator, and the programmable filters. The demo disk comes with over 20 different demonstration programs which also serve as programming examples. Three of the demo programs are written in machine language to show what the Arcade Board can really do, and the rest are written in Applesoft BASIC.

WARRANTY

There is a 180 day warranty on parts and labor for the Arcade Board. Units out of warranty will be repaired for a nominal fee, usually under $20.00.

PRICE, AVAILABILITY, AND 14 DAY MONEY BACK GUARANTEE

We are offering the Arcade Board for the special introductory price of $225, good until January 1, 1984. If your local dealer does not carry the Arcade Board, you may order directly from us. There is a 14 day evaluation period for mail order customers; if not satisfied, return the Arcade Board within 14 days, in original condition, and receive a complete refund (less shipping costs) of your purchase price.

For prepaid orders we accept VISA, MASTERCARD, cashier's checks, money orders, or personal checks (allow 3 weeks to clear). For C.O.D. orders we accept cashier's checks, money orders, or cash. We have several hundred boards in stock and can ship withing 24 hours of receipt of your order. Allow 2 to 7 days for delivery in the U.S. and 14 days for foreign countries. Shipping anywhere in the U.S. is $3.00 for U.P.S. Ground (5 - 7 days) and $6.00 for U.P.S. Blue Label (2 - 3 days). California residents must add 6.5% sales tax.

COMMERCIAL SOFTWARE SUPPORT

In addition to plans to market our own software, we are also negotiating with several commercial software authors to create games and utilities for the Arcade Board. Several companies have our boards and are already writing software for them. Avant Garde Creations, Inc. of Eugene, Oregon plans to market a major software package for the Arcade Board before Christmas, 1983.